

00100100 Example 1

| | SI | C1 ABC | C2 ABC | C3 ABC | S0 | |
|-----|-----------|-----------|-----------|-----------|-----------|--|
| PS1 | | ABC | ABC | ABC | | |
| CP1 | | 000 | 000 | 000 | | |
| SH1 | 001001001 | 010 | 001 | 011 | 010001011 | Tests: C1 000-010, C2 000-001, C3 000-011 decode |
| PS2 | | 001 | 001 | 001 | | |
| CP2 | | 010 | 110 | 010 | | |
| SH2 | 010010010 | 010 | 010 | 010 | 010110010 | Tests: C1 001-010, C2 001-110, C3 001-010 decode |
| PS3 | | 010 | 010 | 010 | | |
| CP3 | | 011 | 011 | 011 | | |
| SH3 | 011011011 | 011 | 011 | 011 | 011011101 | Tests: C1 010-011, C2 010-011, C3 010-101 decode |
| PS4 | | 011 | 011 | 011 | | |
| CP4 | | 110 | 100 | 100 | | |
| SH4 | 100100100 | 100 | 100 | 100 | 110100100 | Tests: C1 011-110, C2 011-100, C3 011-100 decode |
| PS5 | | 100 | 100 | 100 | | |
| CP5 | | 101 | 101 | 101 | | |
| SH5 | 101101101 | 101 | 101 | 101 | 101101101 | Tests: C1 100-101, C2 100-101, C3 100-101 decode |
| PS6 | | 101 | 101 | 111 | | |
| CP6 | | 110 | 110 | 000 | | |
| SH6 | 110110110 | 110 | 110 | 110 | 110110000 | Tests: C1 101-110, C2 101-110, C3 101-111 decode |
| PS7 | | 110 | 110 | 110 | | |
| CP7 | | 011 | 111 | 111 | | |
| SH7 | 111111111 | 111 | 111 | 111 | 011111111 | Tests: C1 110-011, C2 110-111, C3 110-111 decode |
| PS8 | | 111 | 111 | 111 | | |
| CP8 | | 110 | 100 | 000 | | |
| SH8 | xxxxxxx | xxx | xxx | xxx | 110100000 | Tests: C1 111-110, C2 111-100, C3 111-000 decode |

C3 Table

| PS ABC | NS DEF ABC |
|-----------|---------------|
| 000 | 011 011 |
| 001 | 010 010 |
| 010 | 101 101 |
| 011 | 100 100 |
| 100 | 101 101 |
| 101 | 111 111 |
| 110 | 111 111 |
| 111 | 000 000 |

C2 Table

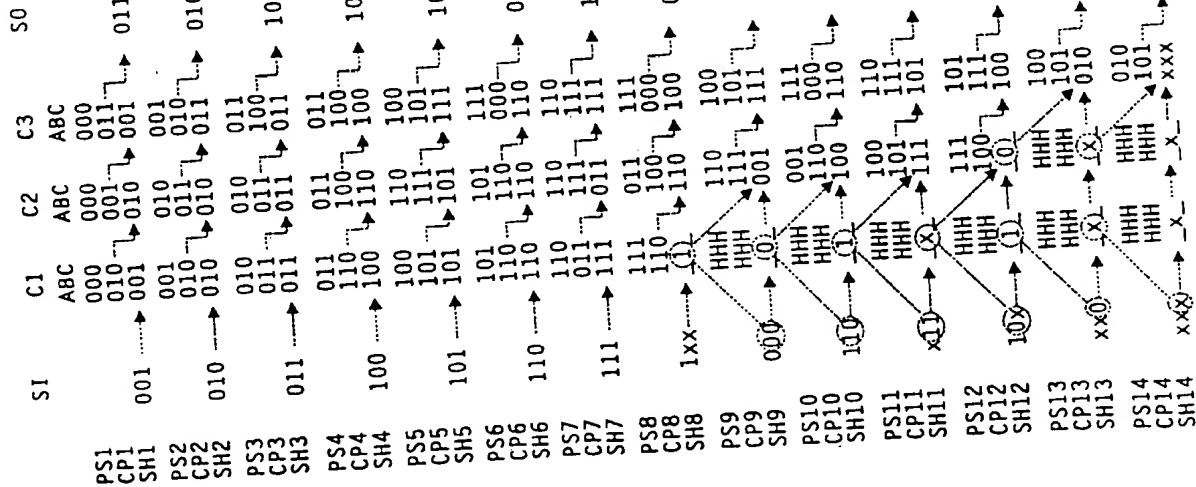
| PS ABC | NS DEF ABC |
|-----------|---------------|
| 000 | 001 001 |
| 001 | 110 110 |
| 010 | 011 011 |
| 011 | 100 100 |
| 100 | 101 101 |
| 101 | 110 110 |
| 110 | 111 111 |
| 111 | 100 100 |

C1 Table

| PS ABC | NS DEF ABC |
|-----------|---------------|
| 000 | 010 010 |
| 001 | 010 010 |
| 010 | 011 011 |
| 011 | 110 110 |
| 100 | 101 101 |
| 101 | 110 110 |
| 110 | 011 011 |
| 111 | 110 110 |

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 72 = 80

Example 2



C1 Table

| PS | ABC | DEF | NS |
|-----|-----|-----|-----|
| 000 | 010 | 010 | 010 |
| 001 | 010 | 010 | 010 |
| 010 | 011 | 011 | 011 |
| 011 | 110 | 110 | 110 |
| 100 | 101 | 101 | 101 |
| 101 | 110 | 110 | 110 |
| 110 | 011 | 011 | 011 |
| 111 | 110 | 110 | 110 |

C2 Table

| PS | ABC | DEF | NS |
|-----|-----|-----|-----|
| 000 | 001 | 001 | 001 |
| 001 | 110 | 110 | 110 |
| 010 | 011 | 011 | 011 |
| 011 | 100 | 100 | 100 |
| 100 | 101 | 101 | 101 |
| 101 | 110 | 110 | 110 |
| 110 | 111 | 111 | 111 |
| 111 | 100 | 100 | 100 |

C3 Table

| PS | ABC | DEF | NS |
|-----|-----|-----|-----|
| 000 | 011 | 011 | 011 |
| 001 | 010 | 010 | 010 |
| 010 | 101 | 101 | 101 |
| 011 | 100 | 100 | 100 |
| 100 | 101 | 101 | 101 |
| 101 | 111 | 111 | 111 |
| 110 | 111 | 111 | 111 |
| 111 | 000 | 000 | 000 |

Tests: C1 000-010, C2 000-001, C3 000-011 decode

Tests: C1 001-010, C2 010-011, C3 001-010 decode

Tests: C1 010-011, C2 010-011, C3 011-100 decode

Tests: C1 011-110, C2 011-100, C3 011-100 decode

Tests: C1 100-101, C2 110-111, C3 100-101 decode

Tests: C1 101-110, C2 101-110, C3 111-000 decode

Tests: C1 110-011, C2 110-111, C3 110-111 decode

Tests: C1 111-110, C2 011-100, C3 111-000 decode

Loads C1's BM with first bit of C2's 001 Stimulus

Tests: C2 110-111, C3 100-101 decode

Bypass C1 & Hold (H) C1's Scan Path

Load C2's remaining 001 stimulus

Tests: C2's remaining 001-110, C3 111-000 decode

Loads C1's BM with first bit of C2's 111 Stimulus

Tests: C2's remaining 100-011, C3 110-111 decode

Tests: Remaining C2 111-100 & C3 101-111 decode

Loads C1's & C2's BM with first 2 bits of C3's 010 stimulus

Bypass C2 & Hold (H) C2's Scan Path

Load C3's remaining 010 stimulus

Tests: C3's remaining 010-101 decode

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 14 + 42 = 56

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 72 = 80

Output - Example 5

Example 5

| | SI | C1 | | S0 | Tests |
|-----|--------|-----|-----|--------|-------------------------------|
| | | ABC | DEF | | |
| PS1 | 001 | 000 | 001 | 010 | C1 000-001, C2 000-010 decode |
| CP1 | | 001 | 010 | | |
| SH1 | | 001 | 011 | | |
| PS2 | 010 | 001 | 011 | 011 | C1 001-010, C2 001-011 decode |
| CP2 | | 010 | 011 | | |
| SH2 | | 010 | 100 | | |
| PS3 | 011 | 010 | 101 | 100 | C1 010-011, C2 010-100 decode |
| CP3 | | 011 | 101 | | |
| SH3 | | 011 | 110 | | |
| PS4 | 100 | 011 | 111 | 101 | C1 011-100, C2 011-101 decode |
| CP4 | | 100 | 101 | | |
| SH4 | | 100 | 110 | | |
| PS5 | 101 | 101 | 110 | 110 | C1 100-101, C2 100-110 decode |
| CP5 | | 101 | 110 | | |
| SH5 | | 101 | 111 | | |
| PS6 | 110 | 110 | 111 | 111 | C1 101-110, C2 101-111 decode |
| CP6 | | 110 | 111 | | |
| SH6 | | 110 | 000 | | |
| PS7 | 111 | 111 | 000 | 000 | C1 110-111, C2 110-000 decode |
| CP7 | | 111 | 001 | | |
| SH7 | | 111 | 010 | | |
| PS8 | xxxxxx | xxx | 000 | 000001 | C1 111-000, C2 111-001 decode |
| CP8 | | xxx | 001 | | |
| SH8 | | xxx | 010 | | |

C1 Table

| PS | NS |
|-----|---------|
| ABC | DEF ABC |
| 000 | 001 010 |
| 001 | 010 011 |
| 010 | 011 100 |
| 011 | 100 101 |
| 100 | 101 110 |
| 101 | 110 111 |
| 110 | 111 000 |
| 111 | 000 000 |

C2 Table

| PS | NS |
|-----|---------|
| ABC | DEF ABC |
| 000 | 010 010 |
| 001 | 010 011 |
| 010 | 100 100 |
| 011 | 100 101 |
| 100 | 110 110 |
| 101 | 110 111 |
| 110 | 000 000 |
| 111 | 000 001 |

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 27 = 35

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 48 = 56

Example 6

| | SI | C1 | | C2 | S0 | |
|-----|--------|-----|-----|-----|--------|--------------------------------------|
| | | ABC | DEF | | | |
| PS1 | 001 | 000 | 001 | 000 | 010 | Tests: C1 000-001, C2 000-010 decode |
| CP1 | | 001 | 010 | 010 | | |
| SH1 | | 001 | 011 | 011 | | |
| PS2 | 010 | 001 | 001 | 001 | 101 | Tests: C1 001-010, C2 001-101 decode |
| CP2 | | 010 | 010 | 010 | | |
| SH2 | | 010 | 011 | 011 | | |
| PS3 | 011 | 010 | 010 | 010 | 110 | Tests: C1 010-011, C2 010-110 decode |
| CP3 | | 011 | 011 | 011 | | |
| SH3 | | 011 | 011 | 011 | | |
| PS4 | 100 | 011 | 011 | 011 | 001 | Tests: C1 011-100, C2 011-001 decode |
| CP4 | | 100 | 001 | 001 | | |
| SH4 | | 100 | 001 | 001 | | |
| PS5 | 101 | 100 | 100 | 100 | 010 | Tests: C1 100-101, C2 100-010 decode |
| CP5 | | 101 | 010 | 010 | | |
| SH5 | | 101 | 011 | 011 | | |
| PS6 | 110 | 101 | 101 | 101 | 101 | Tests: C1 101-110, C2 101-101 decode |
| CP6 | | 110 | 101 | 101 | | |
| SH6 | | 110 | 110 | 110 | | |
| PS7 | 111 | 110 | 110 | 110 | 110 | Tests: C1 110-111, C2 110-110 decode |
| CP7 | | 111 | 111 | 111 | | |
| SH7 | | 111 | 111 | 111 | | |
| PS8 | xxxxxx | 111 | 111 | 111 | 000001 | Tests: C1 111-000, C2 111-001 decode |
| CP8 | | 000 | 001 | 001 | | |
| SH8 | | xxx | 000 | 000 | | |

C1 Table

| PS | NS | |
|-----|-----|-----|
| | ABC | DEF |
| 000 | 01 | 010 |
| 001 | 10 | 101 |
| 010 | 11 | 110 |
| 011 | 00 | 001 |
| 100 | 01 | 010 |
| 101 | 10 | 101 |
| 110 | 11 | 110 |
| 111 | 00 | 001 |

Warping Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 27 = 35

Conventional Scan Test Clocks = Capture Clocks + Shift Clocks = 8 + 48 = 56

Output - Example 70

| | SI | C1 ₁ ABC | C1 ₂ ABC | C1 _{N-1} ABC | C1 _N ABC | S0 |
|-----|-----------|------------------------|------------------------|--------------------------|------------------------|-----------|
| PS1 | 001 | 000 | 000 | 000 | 000 | 001 |
| CP1 | 001 | 001 | 001 | 001 | 001 | 001 |
| SH1 | 001 | 001 | 001 | 001 | 001 | 001 |
| PS2 | 010 | 001 | 001 | 001 | 001 | 010 |
| CP2 | 010 | 010 | 010 | 010 | 010 | 010 |
| SH2 | 010 | 010 | 010 | 010 | 010 | 010 |
| PS3 | 011 | 010 | 010 | 010 | 010 | 011 |
| CP3 | 011 | 011 | 011 | 011 | 011 | 011 |
| SH3 | 011 | 011 | 011 | 011 | 011 | 011 |
| PS4 | 100 | 011 | 011 | 011 | 011 | 100 |
| CP4 | 100 | 100 | 100 | 100 | 100 | 100 |
| SH4 | 100 | 100 | 100 | 100 | 100 | 100 |
| PS5 | 101 | 100 | 100 | 100 | 100 | 101 |
| CP5 | 101 | 101 | 101 | 101 | 101 | 101 |
| SH5 | 101 | 101 | 101 | 101 | 101 | 101 |
| PS6 | 110 | 101 | 101 | 101 | 101 | 110 |
| CP6 | 110 | 110 | 110 | 110 | 110 | 110 |
| SH6 | 110 | 110 | 110 | 110 | 110 | 110 |
| PS7 | 111 | 110 | 110 | 110 | 110 | 111 |
| CP7 | 111 | 111 | 111 | 111 | 111 | 111 |
| SH7 | 111 | 111 | 111 | 111 | 111 | 111 |
| PS8 | xxx...xxx | 111 | 111 | 111 | 111 | xxx...xxx |
| CP8 | xxx...xxx | 000 | 000 | 000 | 000 | xxx...xxx |
| SH8 | xxx...xxx | xxx | xxx | xxx | xxx | xxx...xxx |

C1 Table

| PS | NS |
|-----|-----|
| ABC | DEF |
| 000 | 001 |
| 001 | 010 |
| 010 | 011 |
| 011 | 100 |
| 100 | 101 |
| 101 | 110 |
| 110 | 111 |
| 111 | 000 |

For L=2000, P=1000, N=1
Warping Scan Test Clocks = 2,000,000
Conventional Scan Test Clocks = 200,000,000

For L=2000, P=1000, N=100
Warping Scan Test Clocks = 2,198,000
Conventional Scan Test Clocks = 200,000,000

For L=2000, P=1000, N=1000
Warping Scan Test Clocks = 3,998,000
Conventional Scan Test Clocks = 2,000,000,000

P = Circuit's test pattern count
L = Circuit's scan path length
C = Capture clock per test pattern
N = Number of circuits

Warping Scan Test Clocks = $P(C+L) + NL$
Conventional Scan Test Clocks = $P(C+NL)$

For large L & P

Warping Scan Test Clocks = $L(P+(N-1))$
Conventional Scan Test Clocks = LPN

FIG. 1 (PRIOR ART)

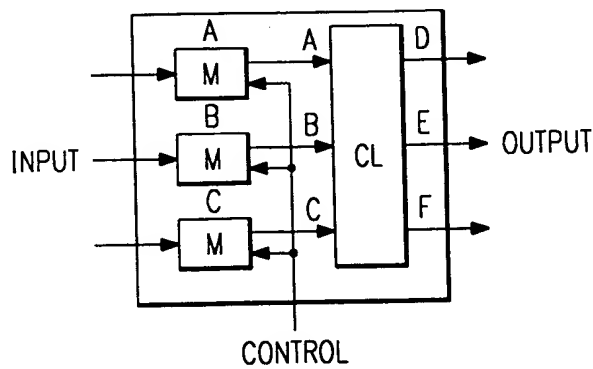


FIG. 2 (PRIOR ART)

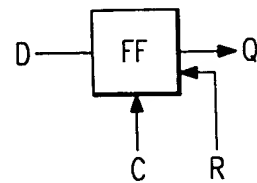


FIG. 3 (PRIOR ART)

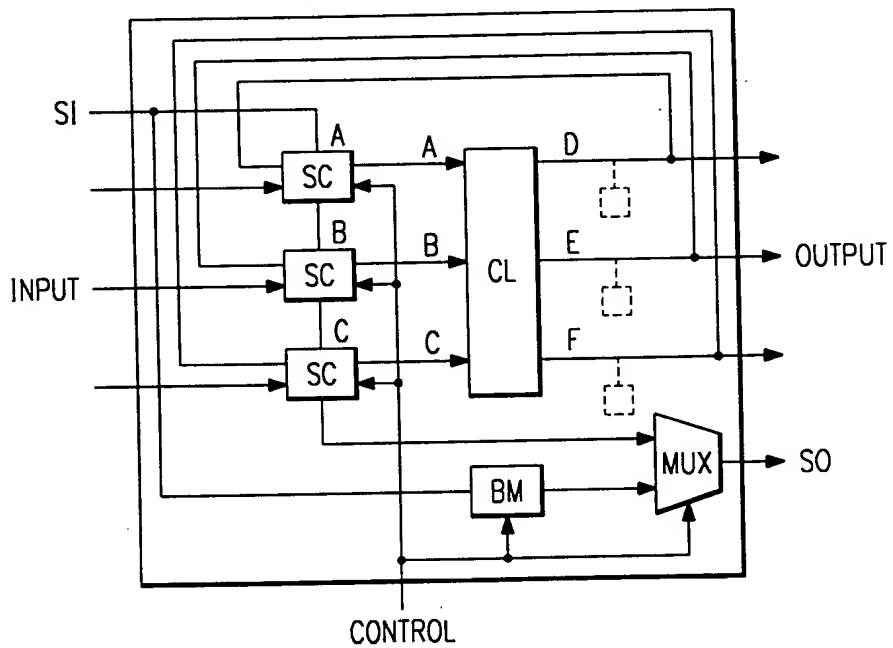


FIG. 4A (PRIOR ART)

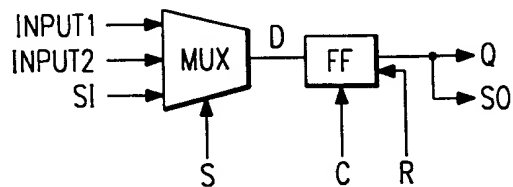


FIG. 4B (PRIOR ART)

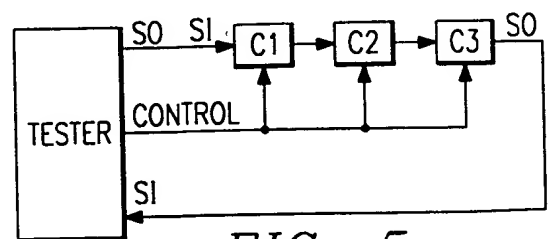
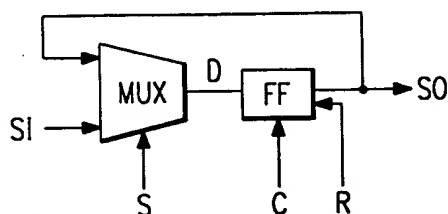


FIG. 5 (PRIOR ART)

FIG. 6
(PRIOR ART)

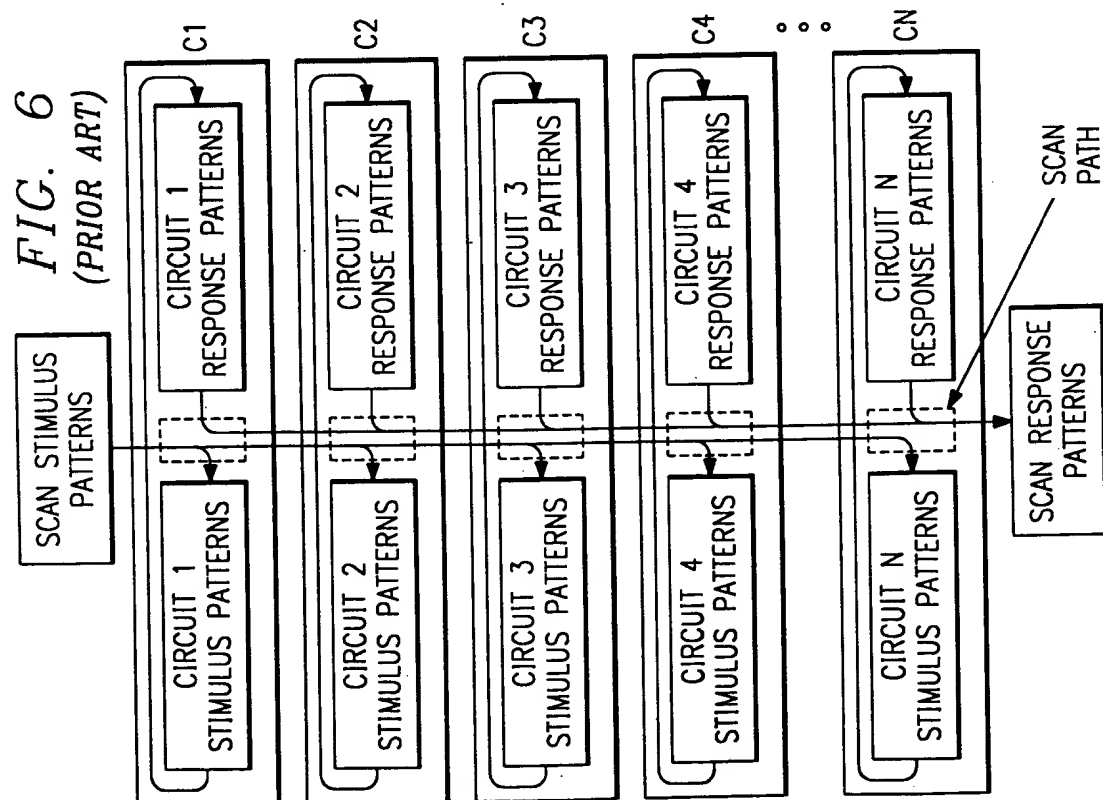


FIG. 7

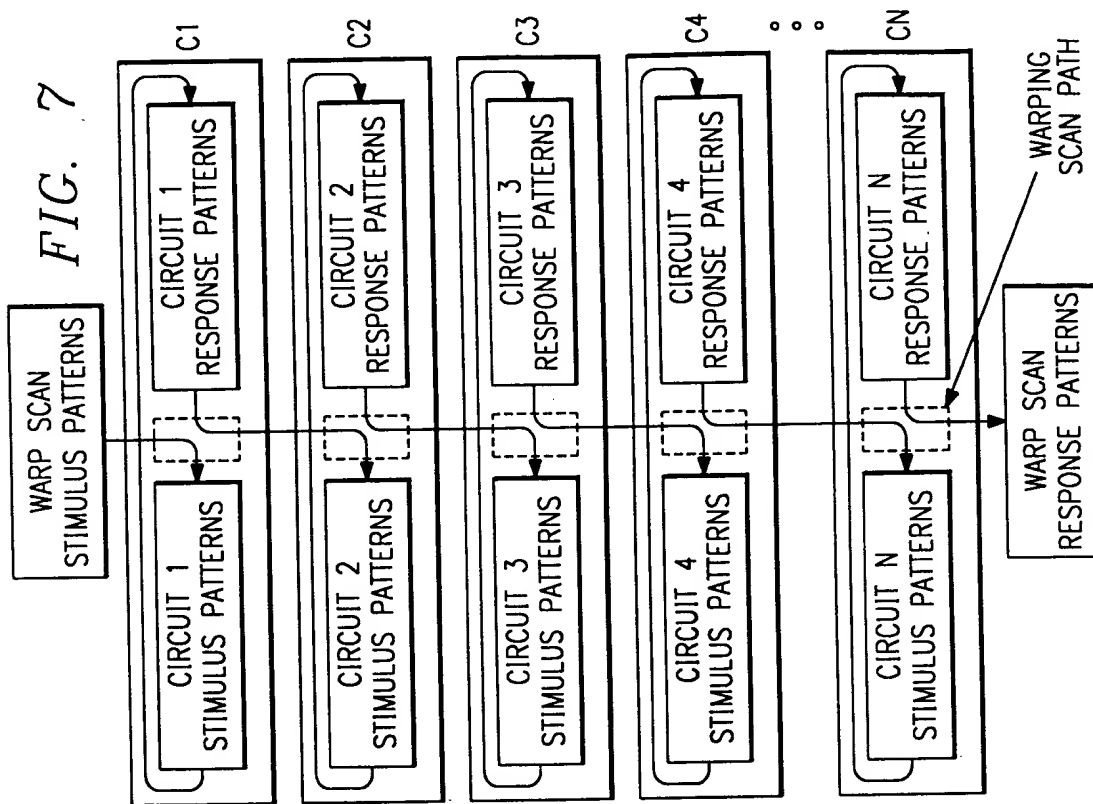


FIG. 8

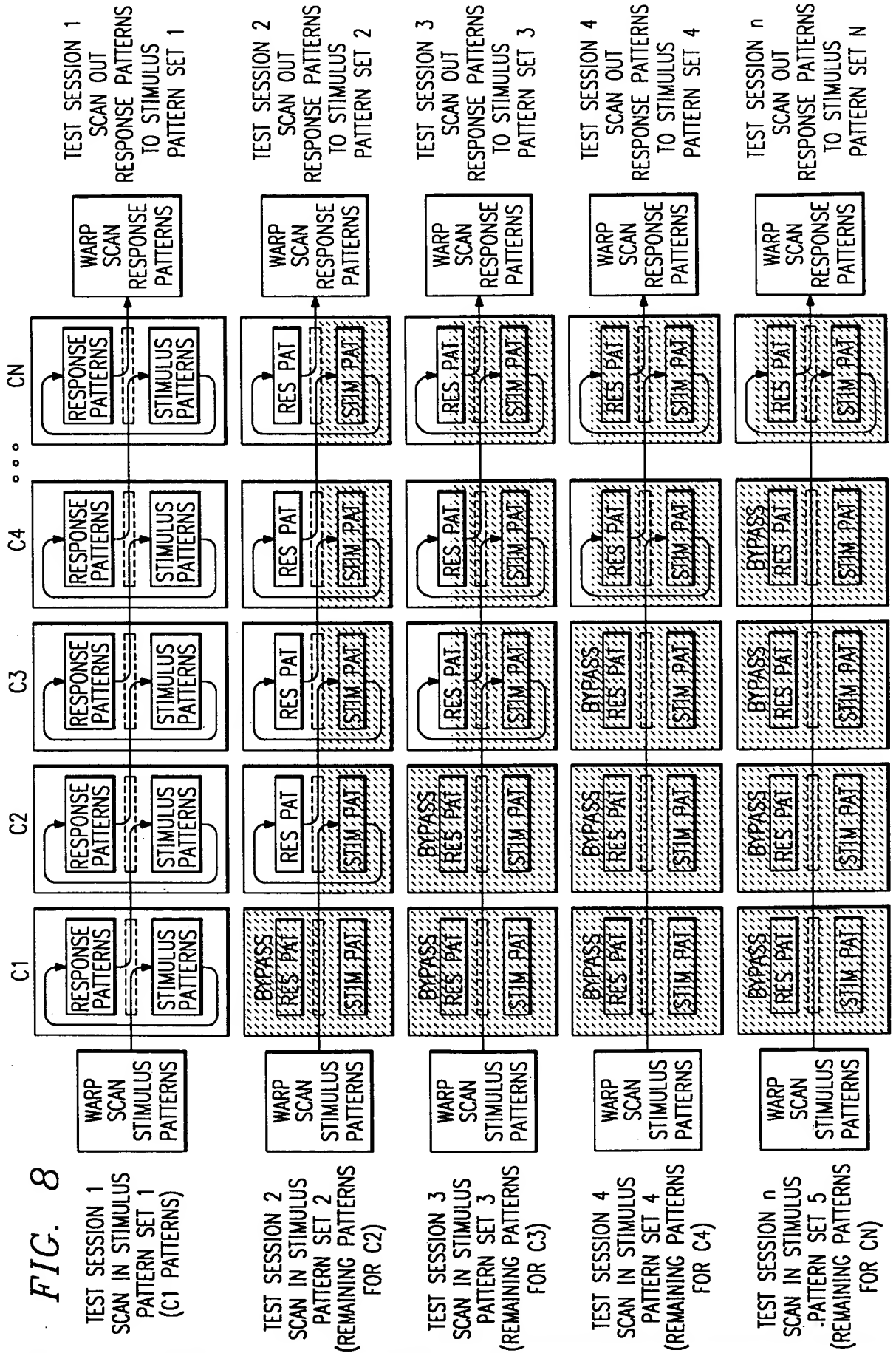


FIG. 9

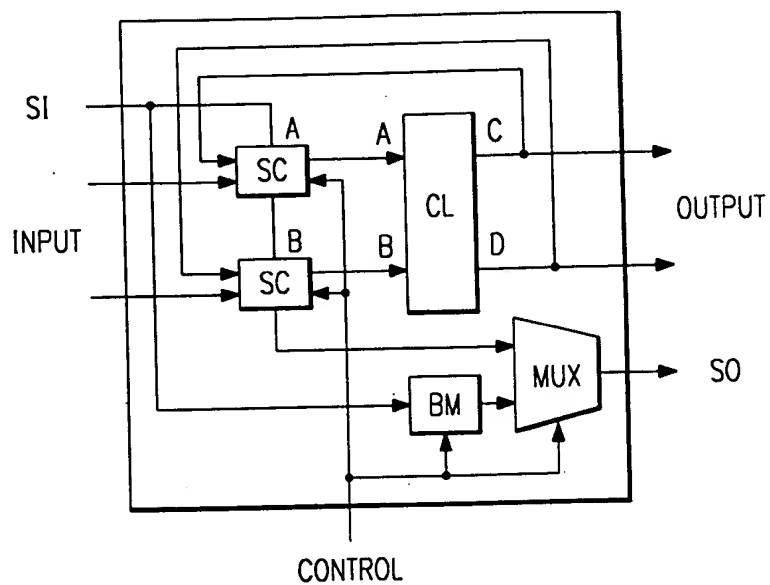


FIG. 10

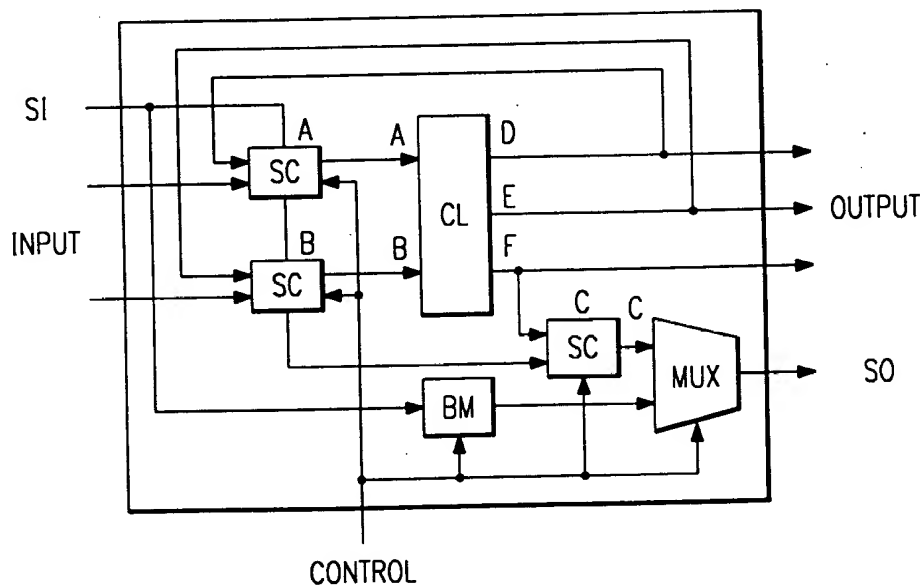


FIG. 11

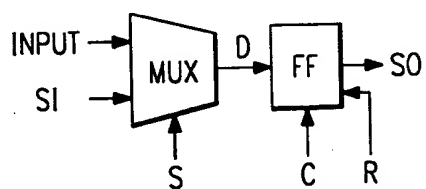


FIG. 12

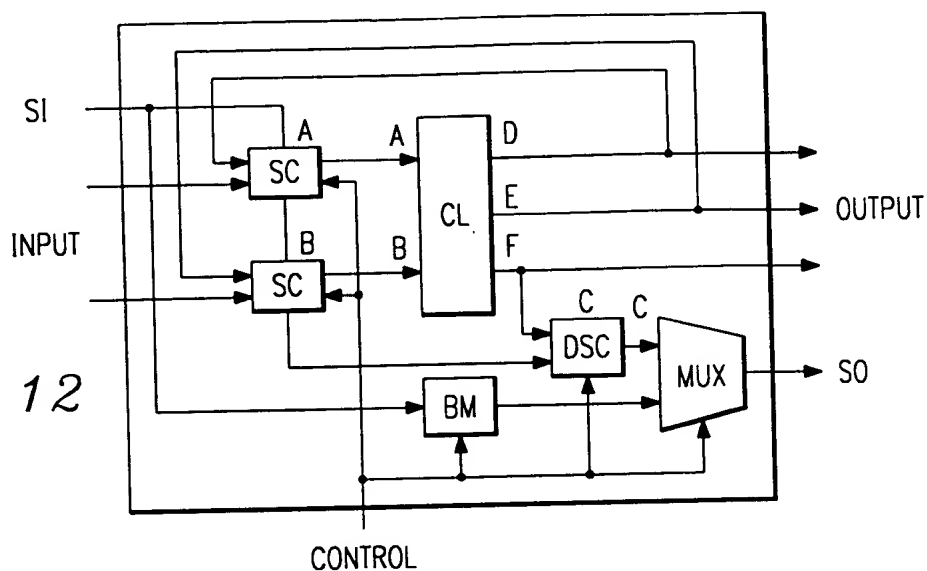


FIG. 13

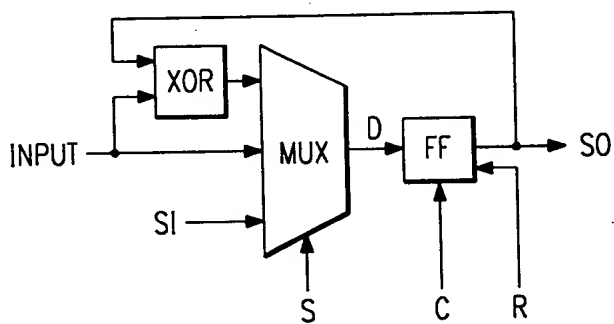


FIG. 15

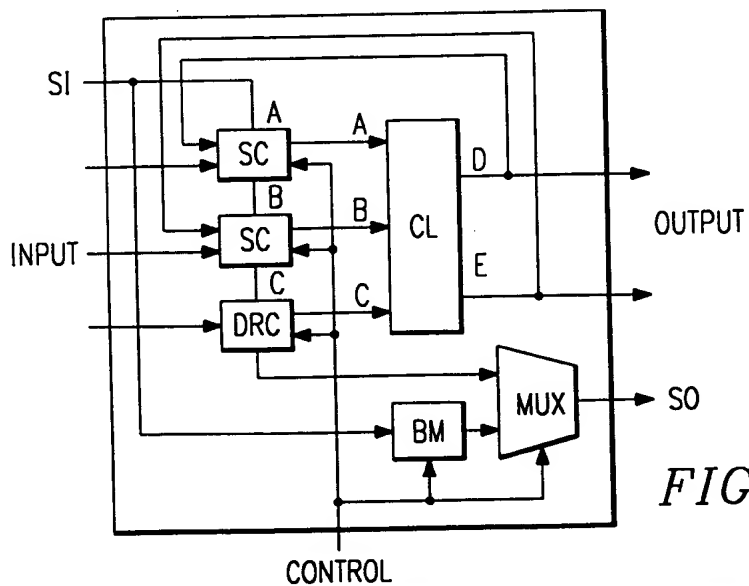
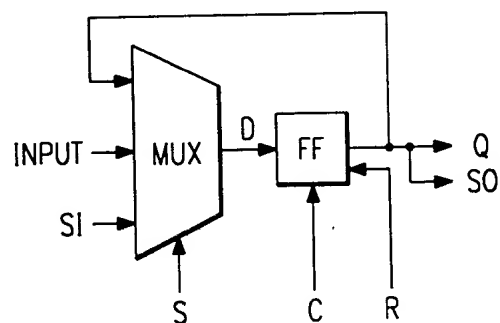


FIG. 14

FIG. 16

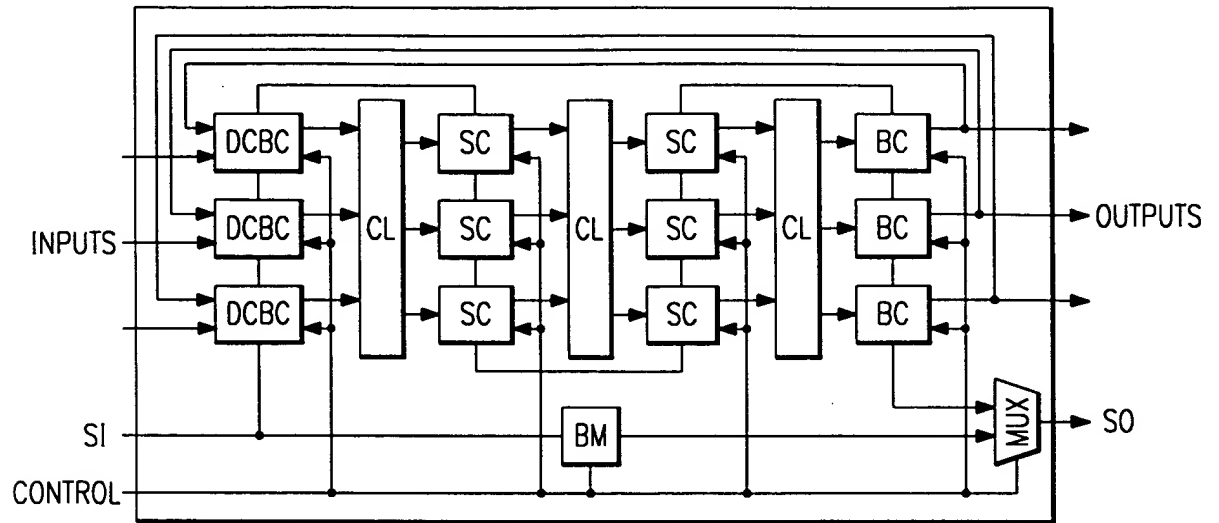


FIG. 17

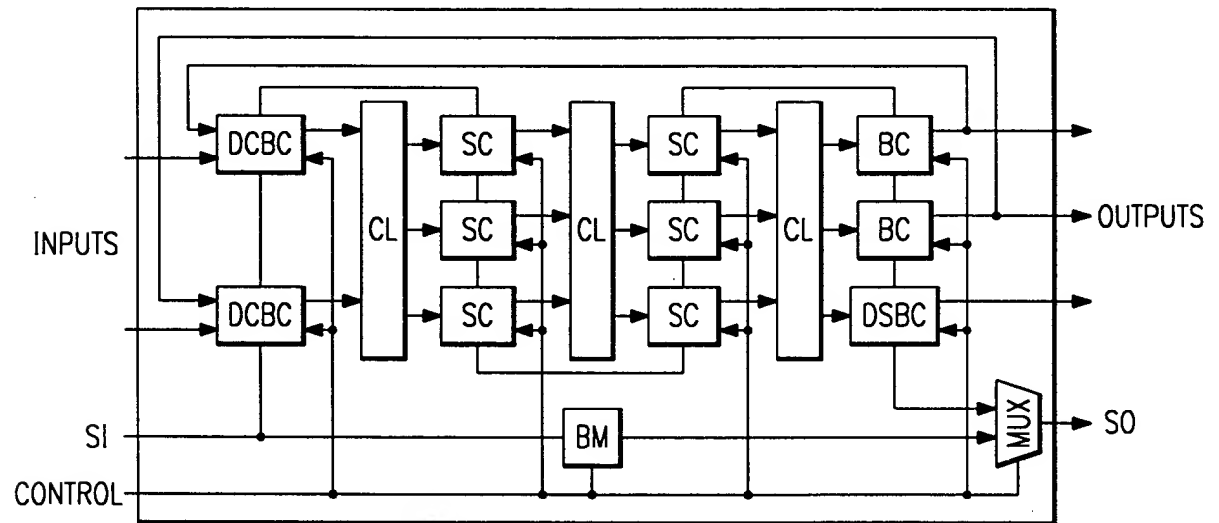


FIG. 18

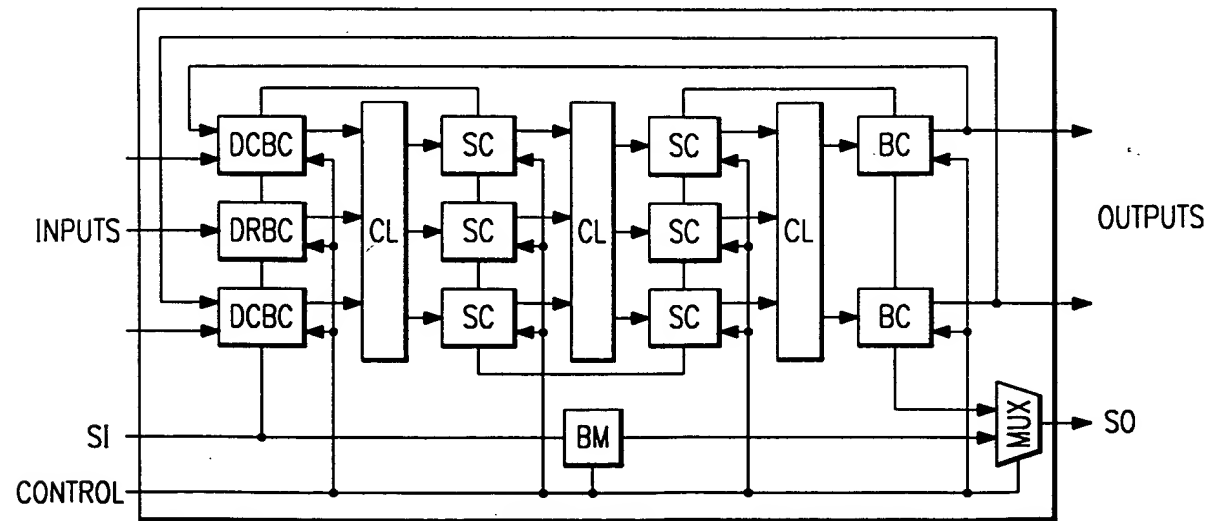


FIG. 19

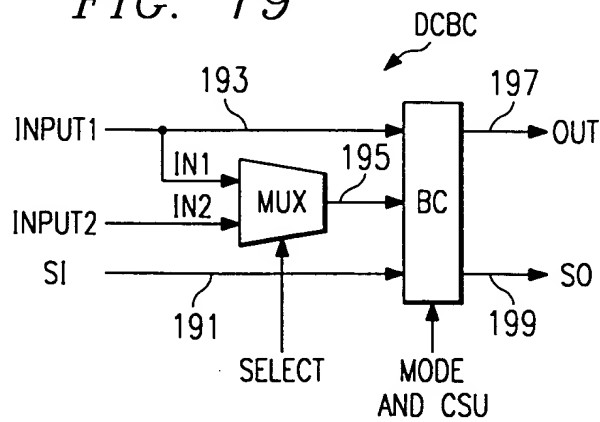


FIG. 20

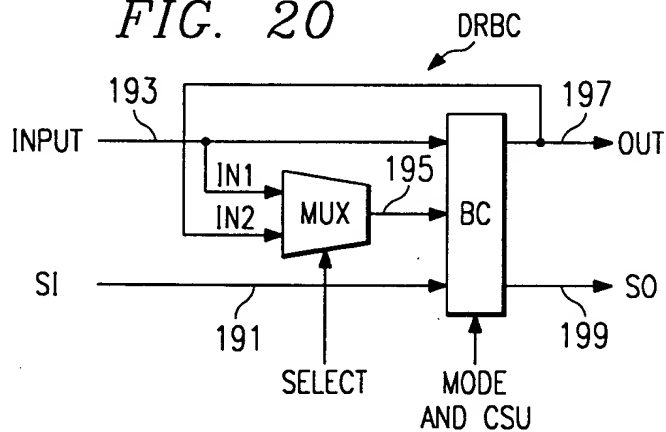
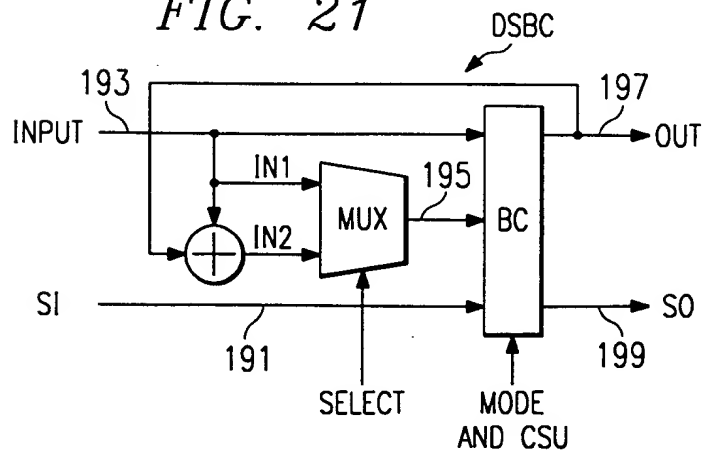


FIG. 21



SELECT = CONVENTIONAL OR WARP SCAN MODE
MODE = CONVENTIONAL BC NORMAL OR TEST MODE CONTROL
CSU = CONVENTIONAL BC CAPTURE, SHIFT, UPDATE CONTROL

FIG. 21A

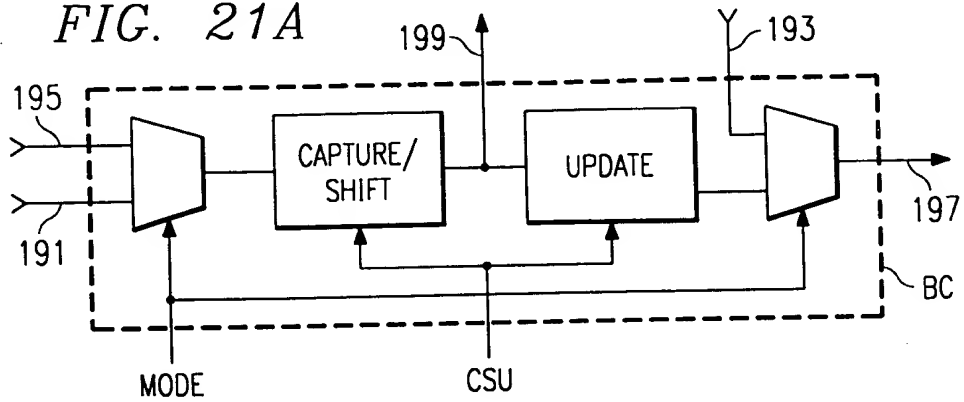


FIG. 22

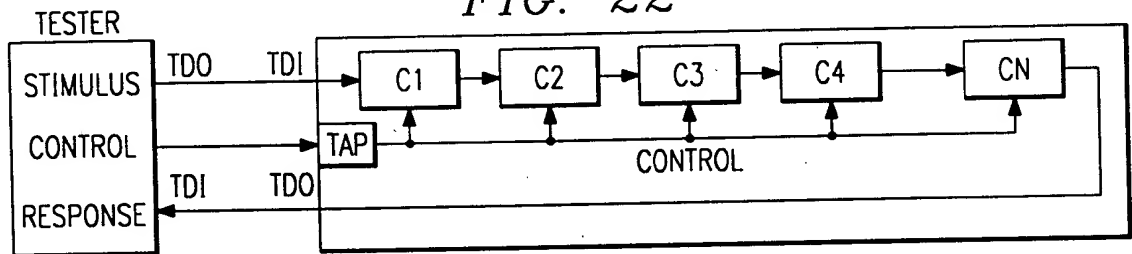


FIG. 23

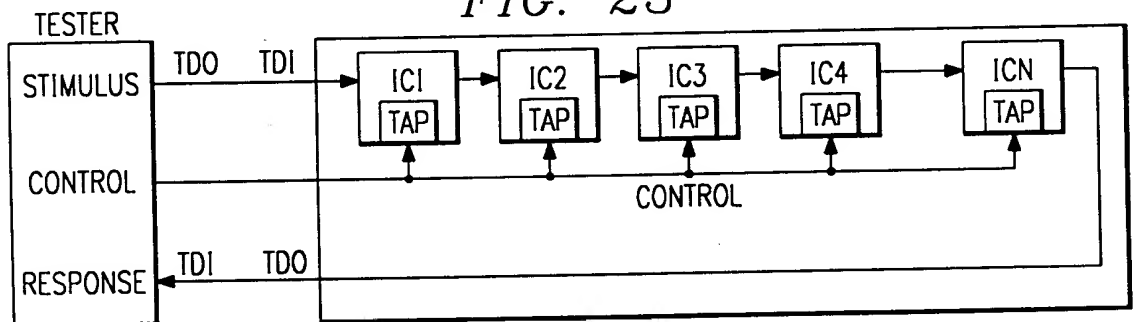


FIG. 24

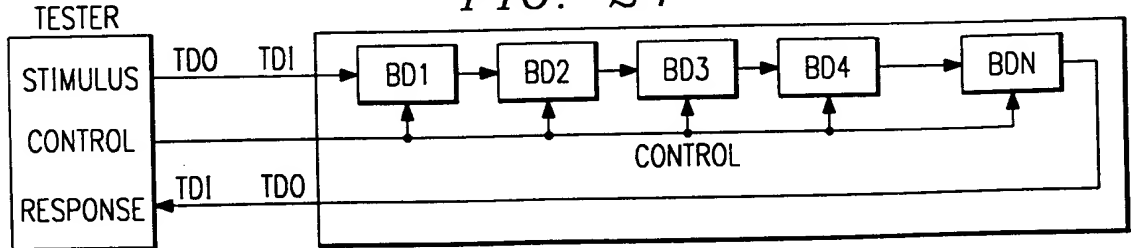
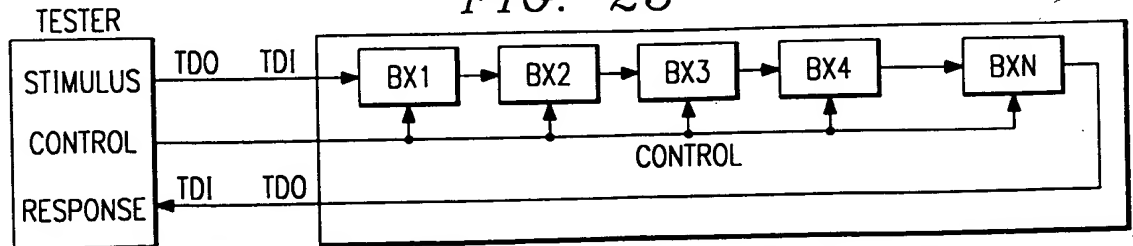


FIG. 25



001221-6594260

FIG. 26

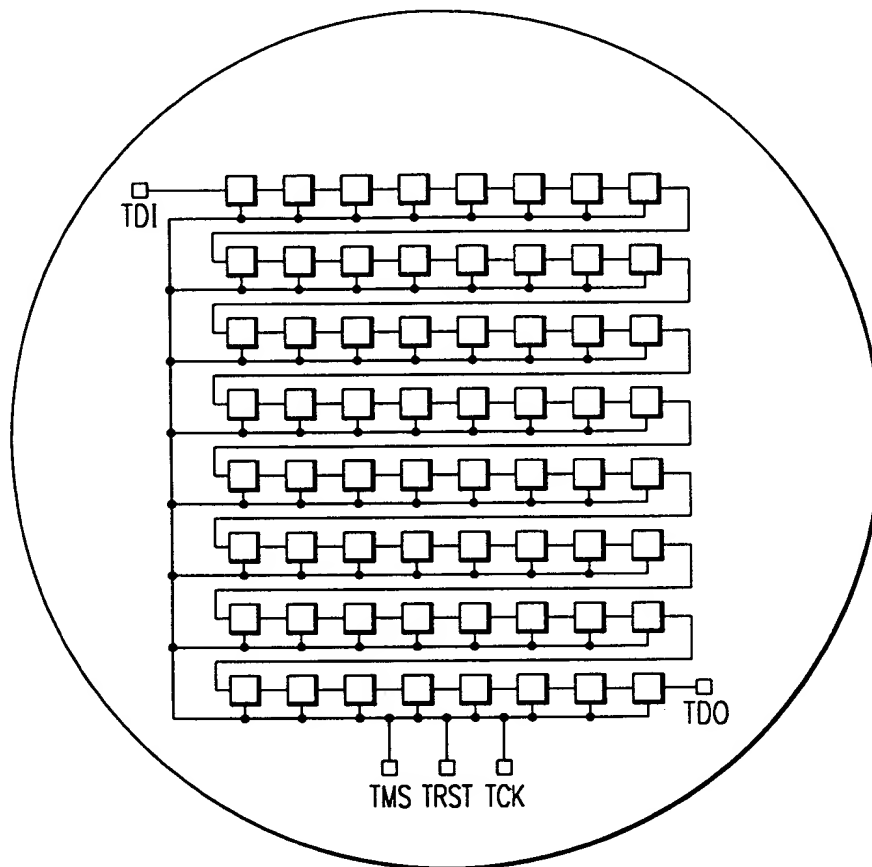


FIG. 27

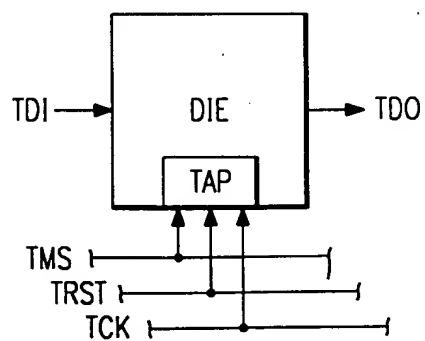
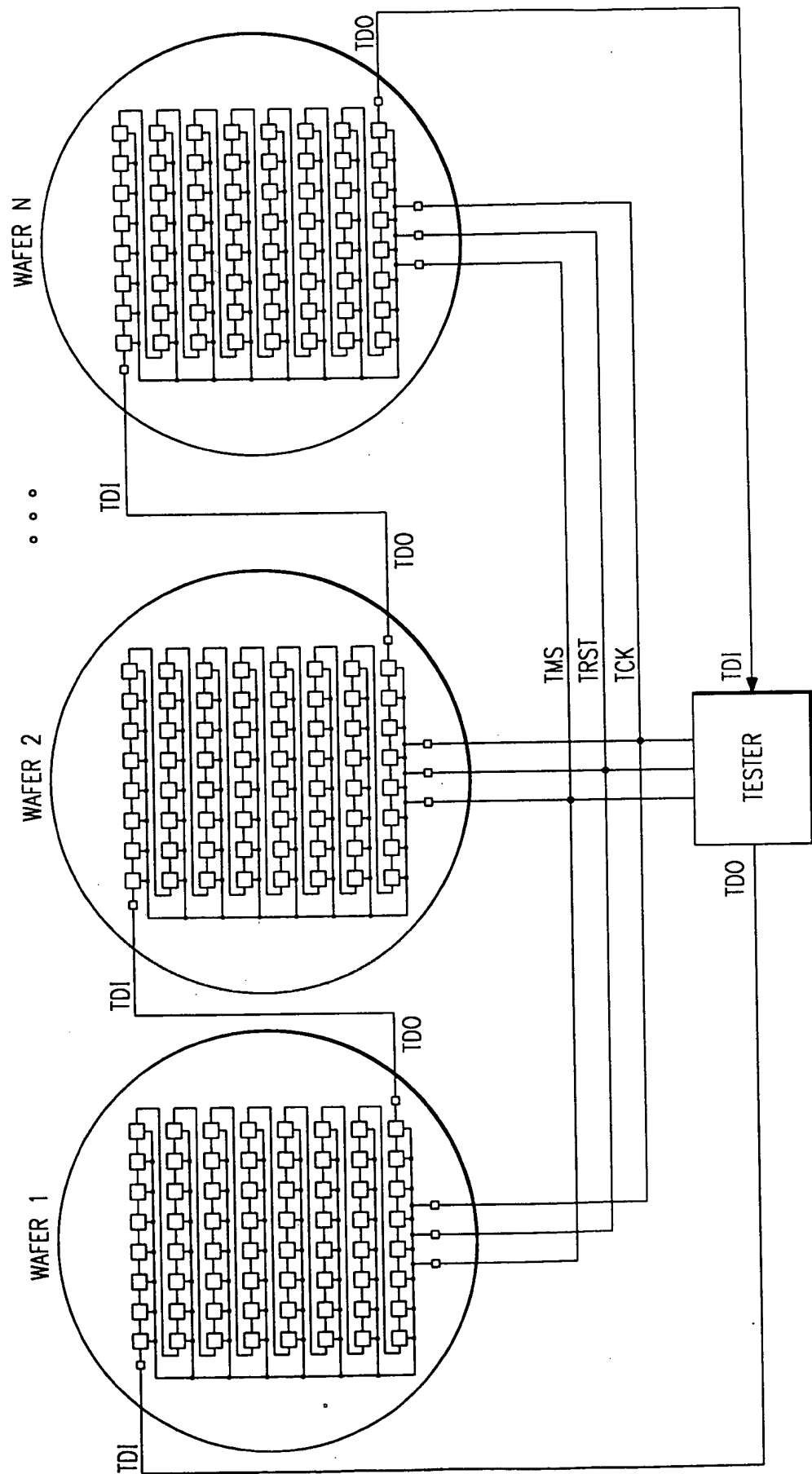
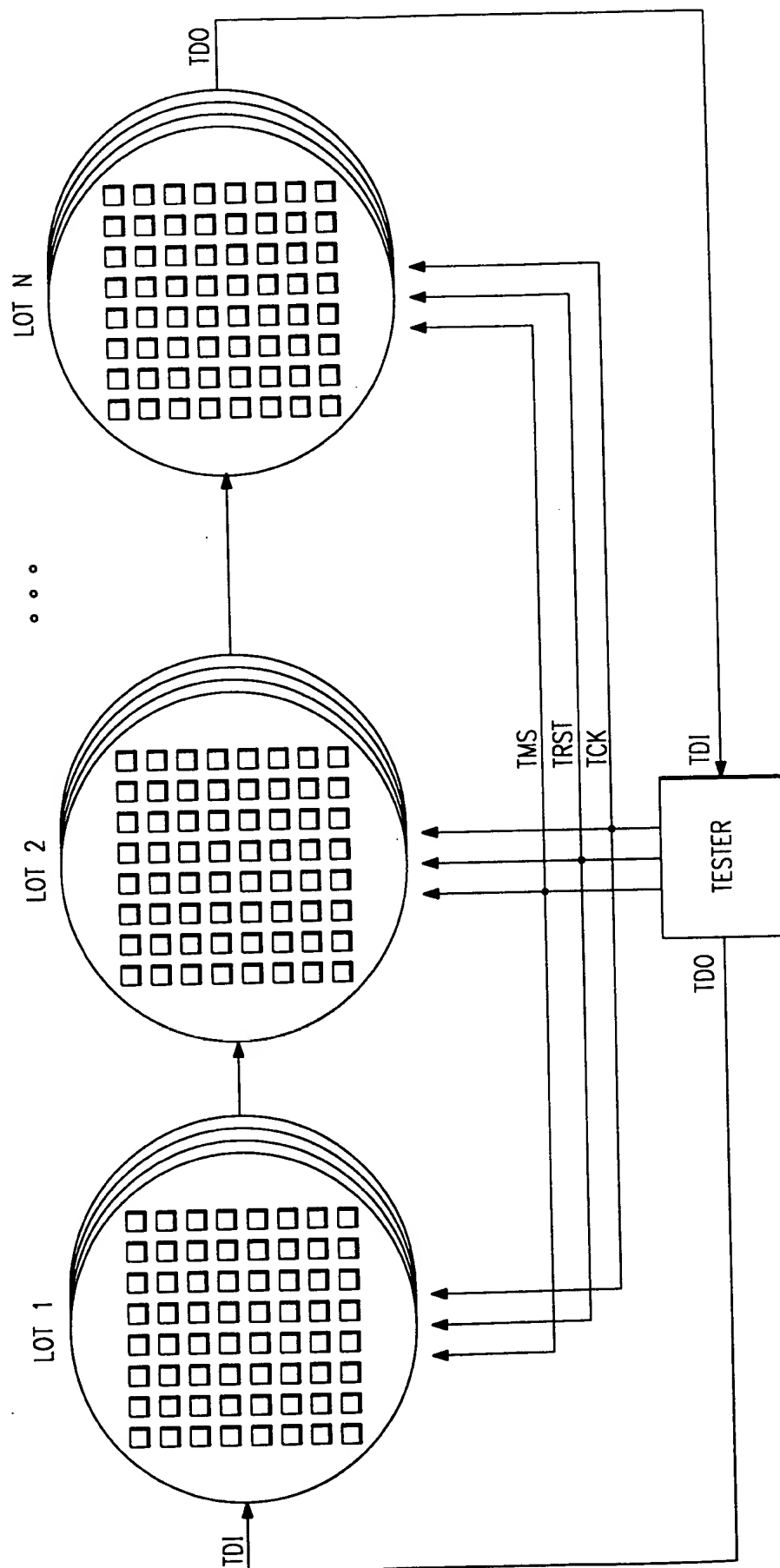


FIG. 28



007227-20000000

FIG. 29



00T22T 2254200

FIG. 30

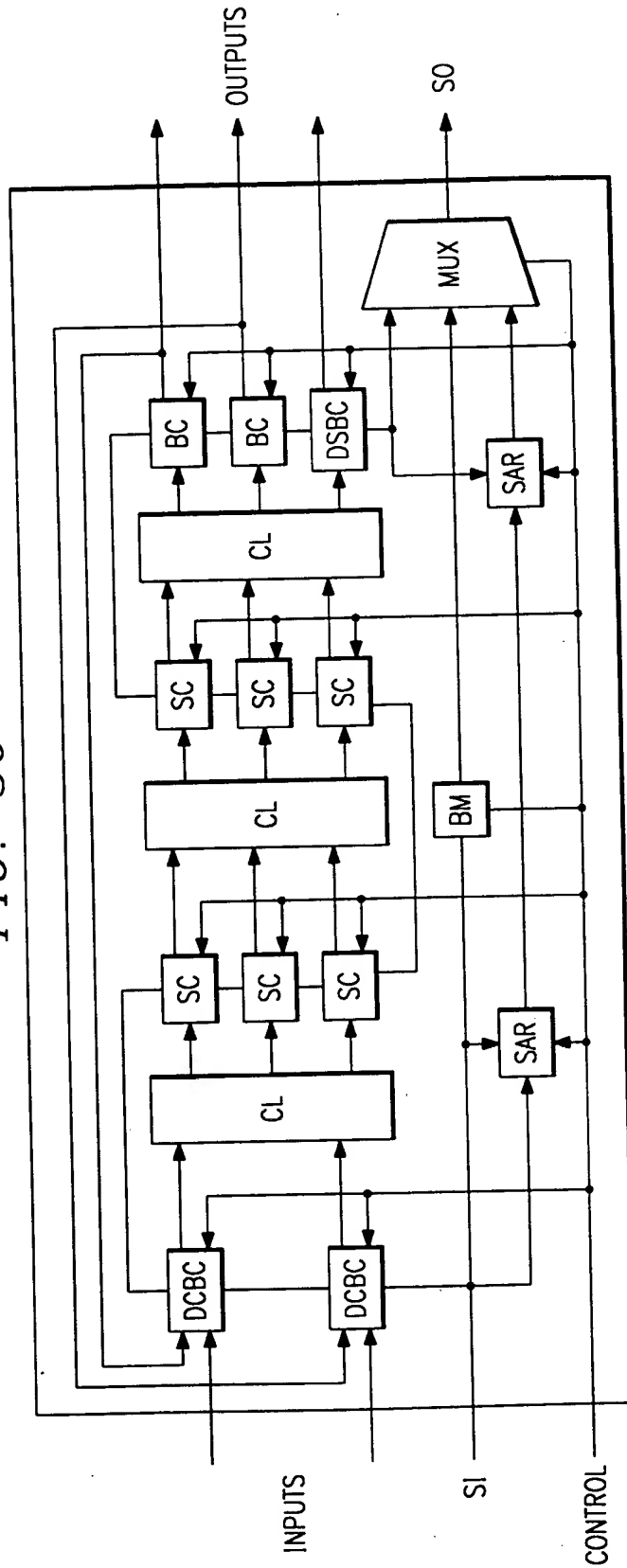


FIG. 31

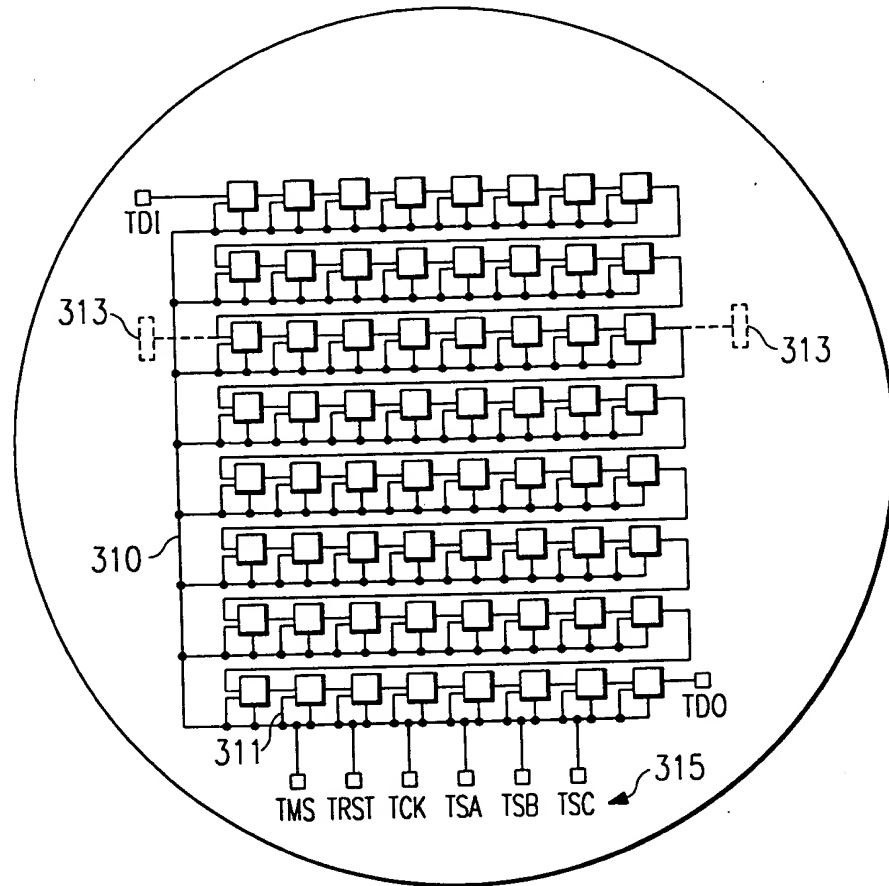


FIG. 32

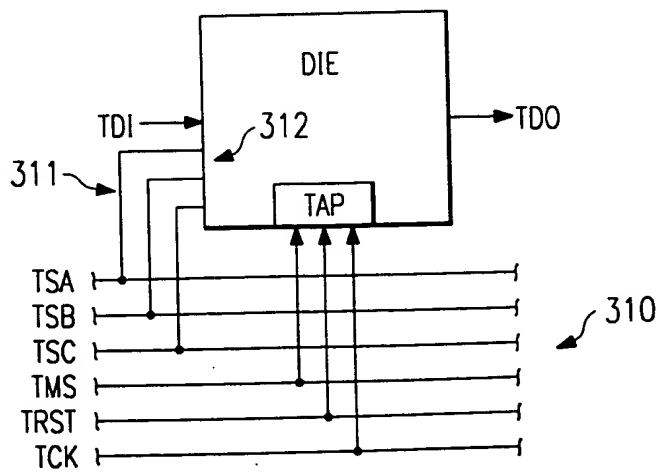


FIG. 33
(PRIOR ART)

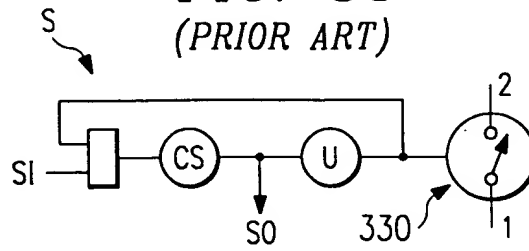


FIG. 34

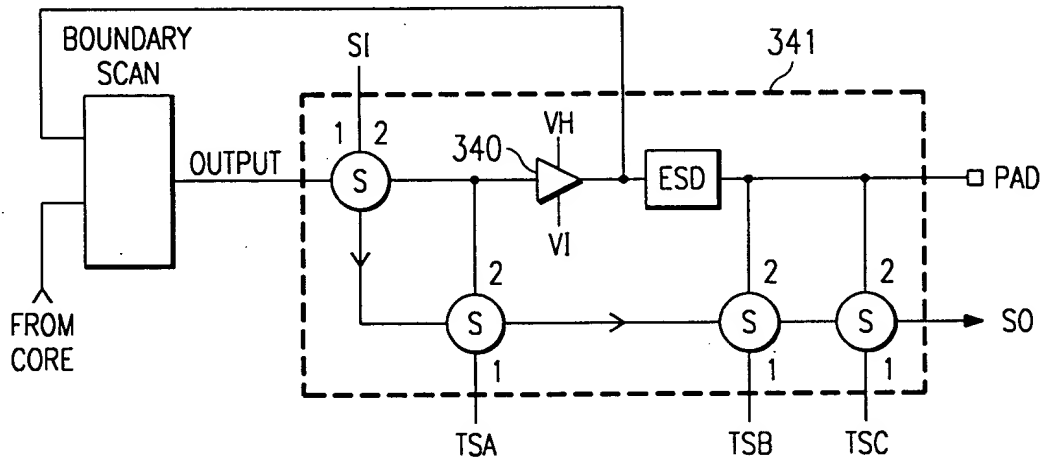


FIG. 35

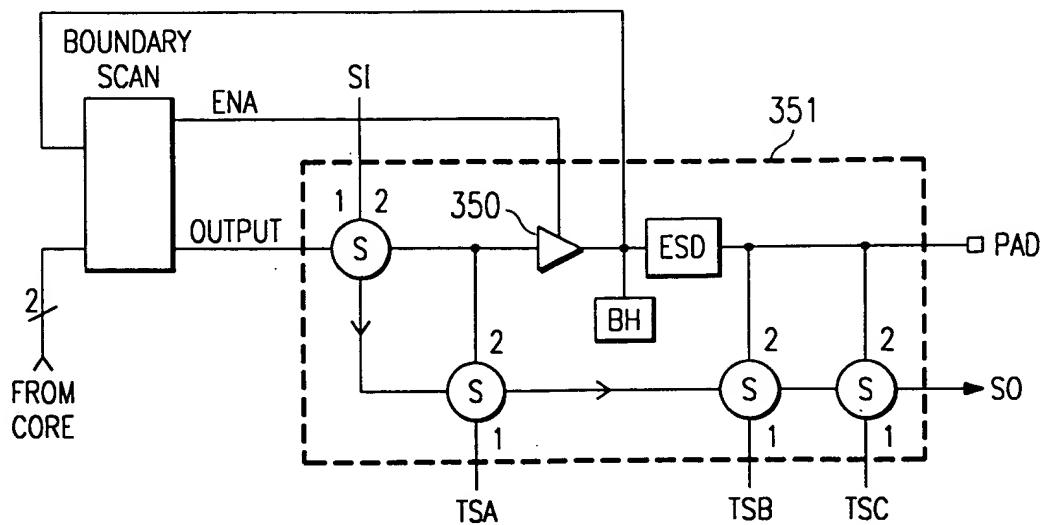


FIG. 36

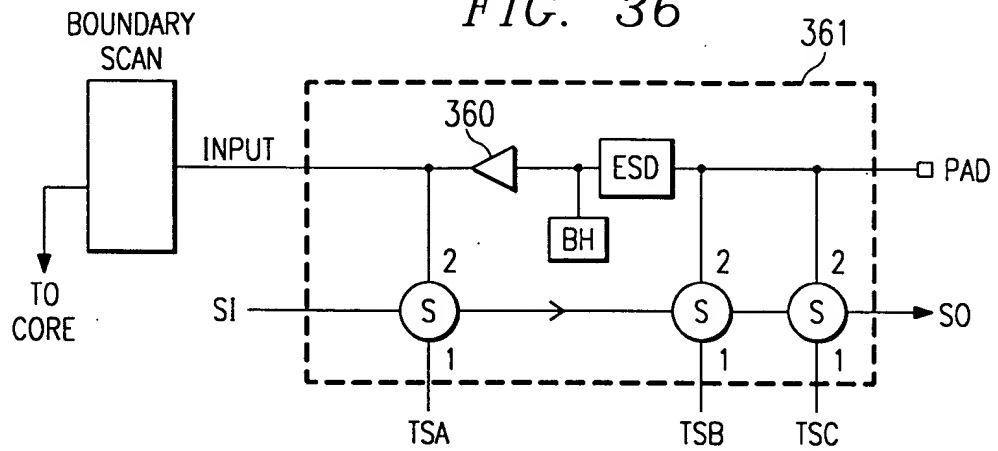


FIG. 37

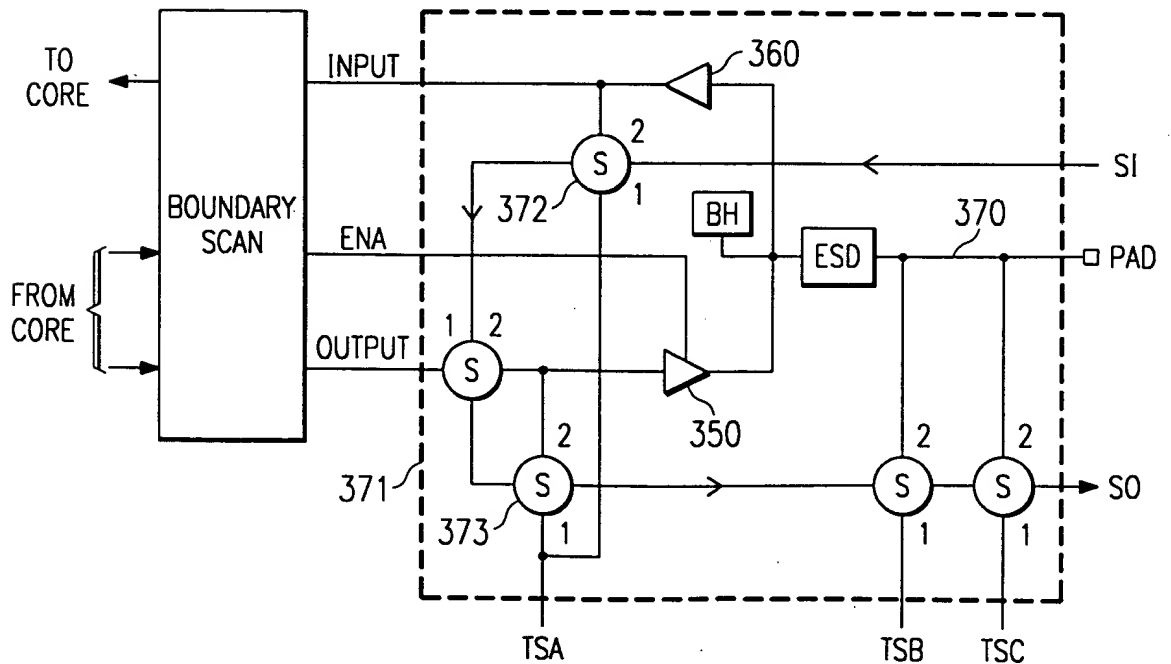


FIG. 38

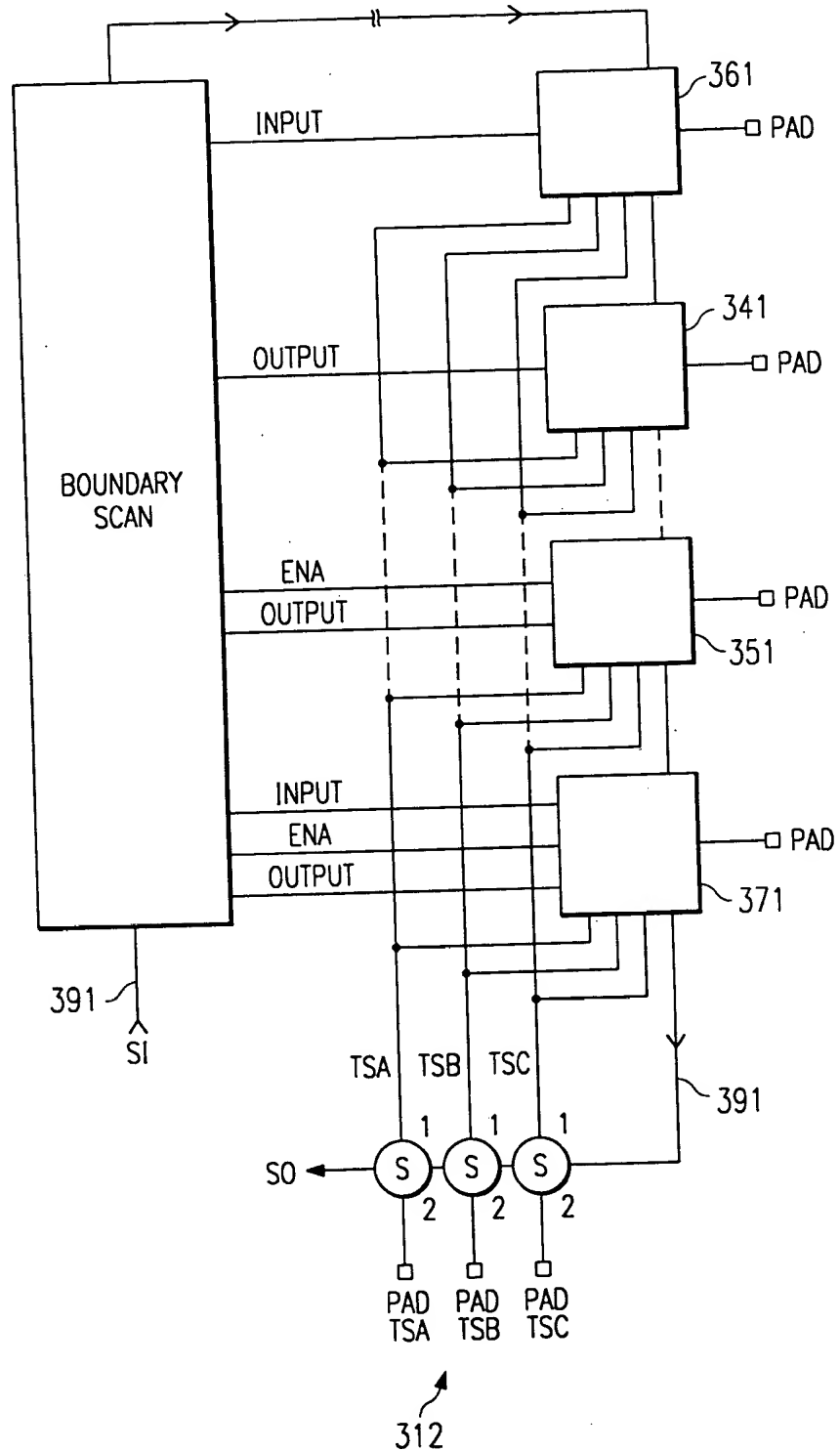


FIG. 39B
(PRIOR ART)

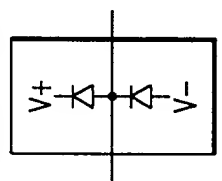


FIG. 39C
(PRIOR ART)

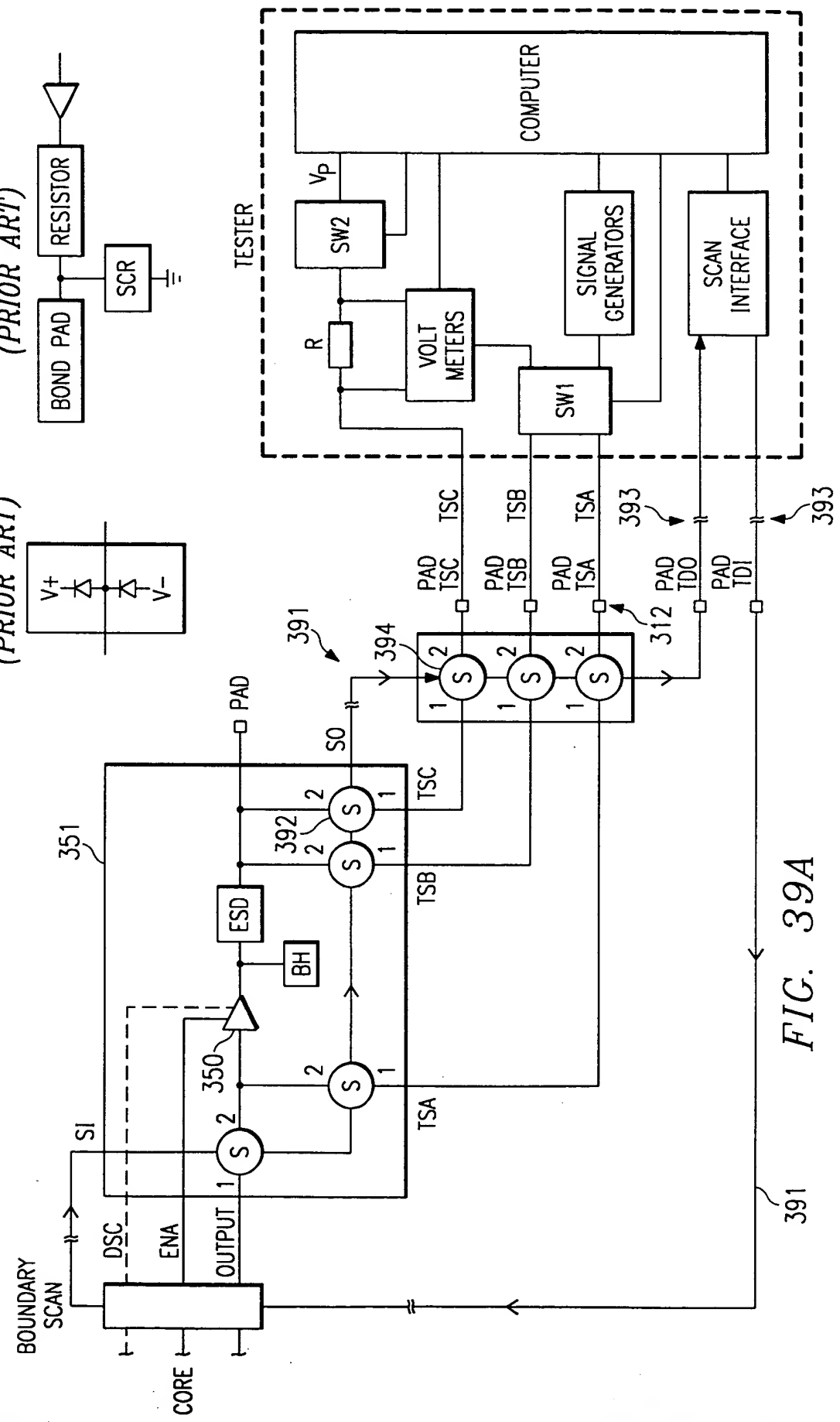
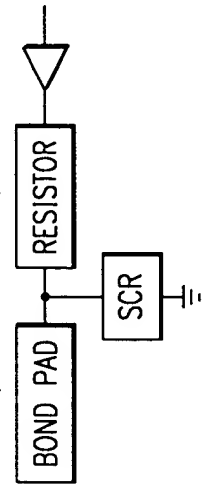


FIG. 40A

FIG. 41

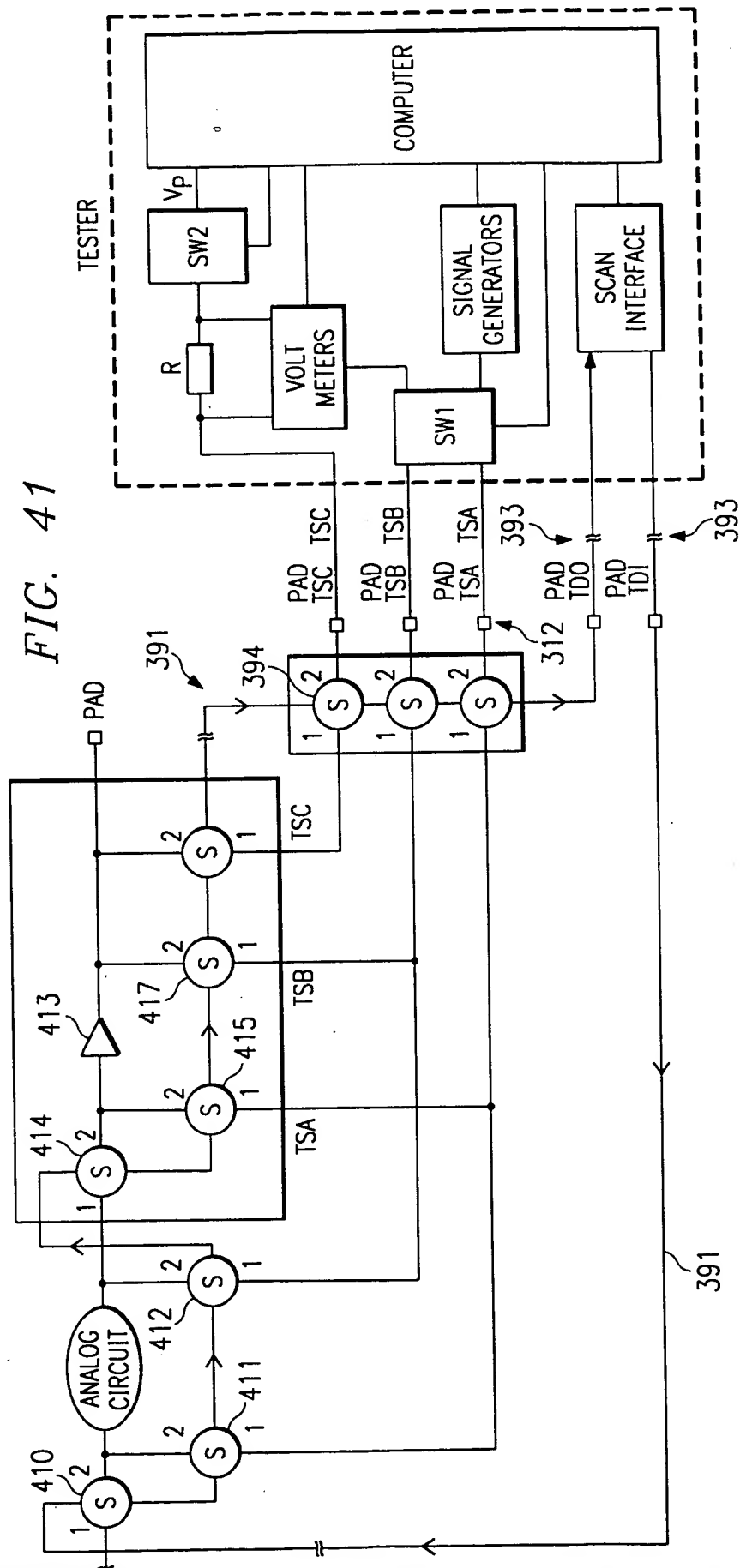


FIG. 42

